

学位論文要旨 Dissertation Abstract

氏名 : Farhana Zaman
Name

学位論文題目 : Study of Allelopathic Potential and Allelopathic Substances
Title of Dissertation of Four Weed Species in Crop Fields
(農地における雑草4種のアレロパシー活性とアレロパシー候補物質の研究)

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Dissertation Abstract

Allelopathy is the action of some chemicals (allelochemicals) exuded by living plants which can inhibit or stimulate the growth and development of other plants. Allelopathy is considered to be one of the ecological strategies of weed control. Allelopathic plants could be used for controlling weeds either through directly utilizing natural allelopathic interactions or by using allelochemicals as natural herbicides. A number of plants, including crops, weeds and trees, have been reported to have allelopathic properties. This study explores the allelopathic potentiality of four weed species in crop fields, and for isolating and identifying allelopathic substances therein.

Species used in the research are *Cyanotis axillaris* (Commelinaceae), *Paspalum commersonii* (Poaceae), *Oxalis europea* (Oxalidaceae) and *Eleocharis atropurpurea* (Cyperaceae), which are competitive weed species in crop fields. The *C. axillaris*, *P. commersonii*, *O. europea*, *E. atropurpurea* aqueous methanol extracts inhibited shoot and root growth of four monocotyledonous (barnyard grass, Italian ryegrass, timothy, foxtail fescue) and four dicotyledonous (cress, lettuce, alfalfa, rapeseed) test plant species at six (0.001, 0.003, 0.01, 0.03, 0.1 and 0.3 g dry weight equivalent extract/mL) different concentrations. The shoot and root growth of all test plants experienced greater than 50% inhibition of control growth at the concentration of 0.1 g dry weight equivalent extract/mL by the extracts of *C. axillaris*, *P. commersonii*, *O. europea* and *E. atropurpurea*. The I_{50} values (concentration required for 50% growth inhibition) of the extracts of *C. axillaris*, *P. commersonii*, *O. europea* and *E. atropurpurea* for test plants

growth ranged from 0.003 to 0.036, 0.002 to 0.085, 0.002 to 0.026 and 0.002 to 0.097 g dry weight equivalent extract/mL, respectively. Weed species extracts inhibitory activities were concentration and species dependent, which indicates that those extracts may have allelopathic potential with allelopathic substances.

Thus, purification of the extracts was conducted using several chromatographic steps and active substances were finally isolated using HPLC. The isolated substances were identified through HRESIMS and ^1H NMR. Two active substances were isolated from the extracts of *P. commersonii* and characterized as dehydrovomifoliol and loliolide. Three active substances were isolated from the extracts of *E. atropurpurea* and characterized as *trans*-ferulaldehyde, syringaldehyde and acetosyringone.

Dehydrovomifoliol and loliolide inhibited the shoot and root growth of cress at concentrations greater than 3 and 0.03 mM, respectively. The inhibition increased as concentrations of dehydrovomifoliol and loliolide were increased. The I_{50} values of cress shoots and roots were 3.34 and >3.50 mM for dehydrovomifoliol and 0.04 and 0.05 mM for loliolide, respectively. This shows that dehydrovomifoliol and loliolide may be responsible for the inhibitory activity of *P. commersonii*.

The active substances *trans*-ferulaldehyde, syringaldehyde and acetosyringone inhibited the shoot and root growth of cress at concentrations of greater than 3.0 mM, whereas shoot and root growth of barnyard grass began inhibition by *trans*-ferulaldehyde, syringaldehyde and acetosyringone at concentrations of greater than 3.0 mM except acetosyringone on the shoot growth of barnyard grass. The I_{50} values of *trans*-ferulaldehyde, syringaldehyde and acetosyringone for the shoot and root growth of cress and barnyard grass were ranged 0.73 to 4.54 mM. The results indicate that *trans*-ferulaldehyde, syringaldehyde and acetosyringone may exhibit inhibitory activity of *E. atropurpurea*.

Aqueous methanol extracts of *C. axillaris*, *P. commersonii*, *O. europea* and *E. atropurpurea* showed concentration-dependent inhibitory activity on the growth of the test seedlings. Five allelopathic substances were isolated from the extracts of *P. commersonii* and *E. atropurpurea* and these substances displayed inhibitory activity on cress and barnyard grass seedling growth. To the best of our knowledge, this study is the first to report the allelopathic potential of these weed species. Therefore, the allelopathy of *C. axillaris*, *P. commersonii*, *O. europea* and *E. atropurpurea* weeds might have a crucial role in developing alternative weed management strategies.